Relative laboratory volatility of 572 unique tank mixes of Dicamba in closed dome systems

Report:	MRID 51017511. Pai, N., and J.W. Cubbage. 2020. Evaluation of Existing Tank Mix pH and Volatility Potential (as Measured in a Closed Dome) Data. Unpublished study performed and sponsored by Monsanto Company, Chesterfield, Missouri. Reference No.: MSL0030973. Study No.: RAR-2019-0533. Experiment initiation and termination not reported. Final report issued January 14, 2020.
Document No.:	MRID 51017511
Guideline:	Nonguideline
Statements:	The study was not conducted in compliance with U.S. EPA FIFRA (40 CFR part 160) GLP standards, but measures were taken to ensure quality including an in-house QAU unit and QA manager (pp. 4, 6). Signed and dated GLP Compliance, Data Confidentiality, and Certification of Authenticity statements were provided (pp. 2-5). A Quality Assurance statement was not included.
Classification:	This study is **supplemental, non-guideline**. The compositions of the test substances were not reported. The test soil was not characterized. The test soil consisted of 50% Redi-Earth, a soil with a large amount of sphagnum peat moss, which would make it very high in organic carbon. Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not absolute. No method validation data was reported for the method used to quantify dicamba in the PUF.

PC Code:	128931	
Final EPA Reviewer:	Chuck Peck Senior Fate Scientist	Signature: Date: 2020.10.22 10:01:54 -04'00'
CDM/CSS-Dynamac JV Reviewers:	Lisa Muto, M.S. Environmental Scientist	Signature: Date: 03/28/2020
	Richard Lester Environmental Scientist	Signature: Date: 03/28/2020

This Data Evaluation Record may have been altered by the Environmental Fate and Effects Division subsequent to signing by CDM/CSS-Dynamac Joint Venture personnel. The CDM/CSS-Dynamac JV role does not include establishing Agency policies

Executive Summary

This study is a summary of tank mix pH and corresponding air concentration data from humidome studies in which XtendiMax® Herbicide with VaporGrip® Technology was mixed with an additional tank mix partner. Data was retrieved from an online third-party database that the study sponsor uses to store humidome test results.

The relative dicamba volatility of 572 unique tank mixtures of XtendiMax™ with VaporGrip™ and other agricultural products was studied in soil under aerobic conditions at set temperature (35°C), humidity (40%), and air flow conditions (*ca.* 3 L/min.) for 24 hours (14 hours of light, 10 hours of darkness). Soil was a 1-liter mixture of a 50 % Redi-Earth and 50 % US10 field soil[1]. Application rates were not reported. Polyurethane foam (PUF) samples were collected after 24 hours. The PUF samples were extracted using methanol, and dicamba was quantitated using LC-MS/MS. No analyses of dicamba in soil were performed, and unextracted residues were not analyzed.

Figure 1 depicts a graphical analysis of the entire dataset (n=572 mixtures). For the entire dataset, pH values ranged from 2.53 to 10.92, with 24-hr air dicamba concentrations ranging from 0.000 $\mu g/m^3$ to 52.93 $\mu g/m^3$. Based on the dimensions of the humidomes provided in Gavlick, et al, 2016, flux rates for the various studies ranged from $2.35x10^{-7}$ to $2.05x10^{-2}$ $\mu g/m^2$-s.

Figures 2 through **8** depicts a graphical analysis for the dataset, based on the type of compound mixed with Xtendimax. For Xtendimax mixtures with adjuvants (n = 174; pH range 4.14-8.94), 24-hr dicamba air concentrations ranged from 0.001 $\mu g/m^3$ to 0.483 $\mu g/m^3$. For Xtendimax mixtures with fungicides (n = 20; pH range 5.25-5.48), 24-hr dicamba air concentrations ranged from 0.004 $\mu g/m^3$ to 0.058 $\mu g/m^3$. For Xtendimax mixtures with herbicides (n = 98; pH range 3.77-8.85), 24-hr dicamba air concentrations ranged from 0.001 $\mu g/m^3$ to 6.200 $\mu g/m^3$. For Xtendimax mixtures with insecticides (n = 46; pH range 5.05-5.68), 24-hr dicamba air concentrations ranged from 0.002 $\mu g/m^3$ to 0.242 $\mu g/m^3$. For Xtendimax mixtures with nutritional compounds (i.e., fertilizers (n = 210; pH range 2.53-10.92), 24-hr dicamba air concentrations ranged from 0.000 $\mu g/m^3$ to 52.931 $\mu g/m^3$. For Xtendimax mixtures with other compounds (n = 7; pH range 4.48-5.61), 24-hr dicamba air concentrations ranged from 0.002 $\mu g/m^3$ to 0.989 $\mu g/m^3$. For Xtendimax mixtures with plant growth regulators (PGRs) (n = 17; pH range 5.14-5.67), 24-hr dicamba air concentrations ranged from 0.004 $\mu g/m^3$ to 0.022 $\mu g/m^3$.

Based on the plots of the pH and dicamba air concentrations for all tank mixes and for each tank mix partner class (shown below), the study author and reviewer conclude that pH does not correlate well with 24-hour dicamba air concentrations and that the measured dicamba air concentrations can vary across pH ranges.

[1] Conditions were assumed to be the same as those reported in the cited reference: Gavlick, WK, DRWright, A MacInnes, JW Hemminghaus, JK Webb, and VI Yermolenka, and W Su. 2016. A method to determine the relative volatility of auxin herbicide formulations. Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587, GR Goss, Ed. ASTM International, WestConshohocken, PA, pp. 24-3, doi:10.1520/STP15842015000.

However, it should be noted that a higher percentage of low pH values generated 24-hour dicamba air concentrations higher than those for Xtendimax Plus Vaporgrip alone. Based on results of a humidome study that assessed temperature and relative humidity effects on the volatility of Xtendimax plus Vaporgrip (MRID 51017509), the pH of the product is typically around 5.2 and the average 24-hour dicamba air concentration at 35C and 40% relative humidity was 6.42 ng/m^3. Using these criteria as cutoffs, 396 partner tank mixes resulted in air concentrations higher than those attributed to Xtendimax plus Vaporgrip alone, while 176 combinations resulted in air concentrations less than the product alone. Of these, 19% of the tank mixes with air concentrations greater than the product alone had pH values less than 5.2, and 81% had concentrations greater than or equal to 5.2. In contrast, only 3% of the tank mixtures with air concentrations less than or equal to the product alone had pH values less than 5.2, and 97% had concentrations greater than or equal to 5.2.

Figure 1. Relationship between pH and 24-hour dicamba air concentrations for all tank mixes.

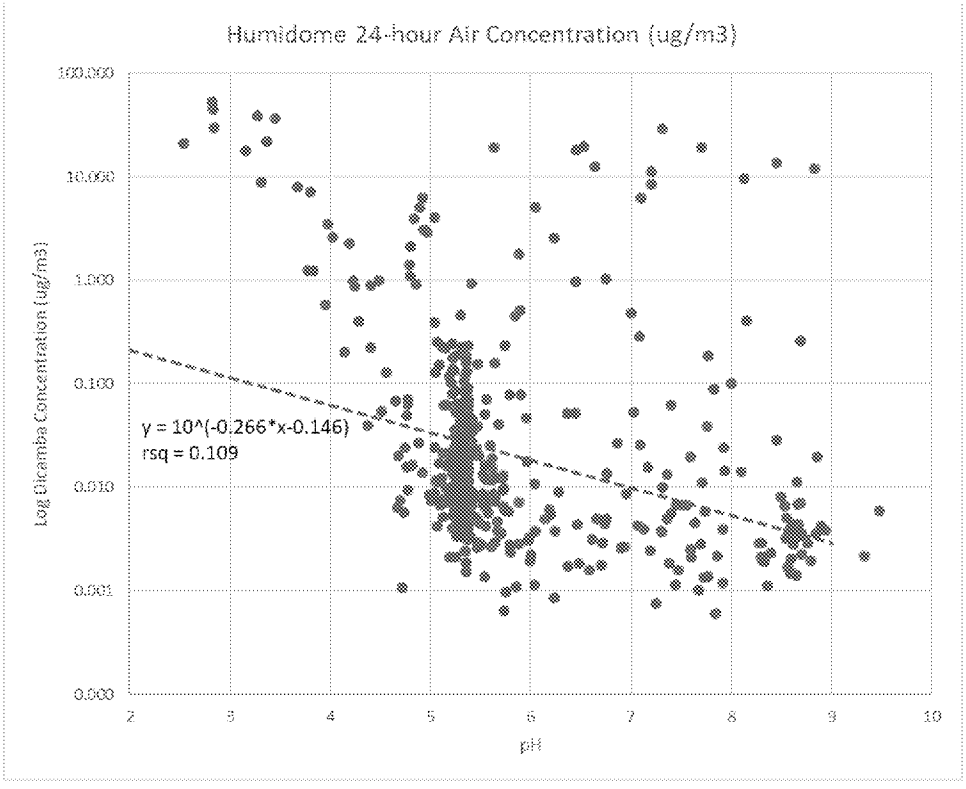


Figure 2. Relationship between pH and 24-hour dicamba air concentrations, adjuvants.

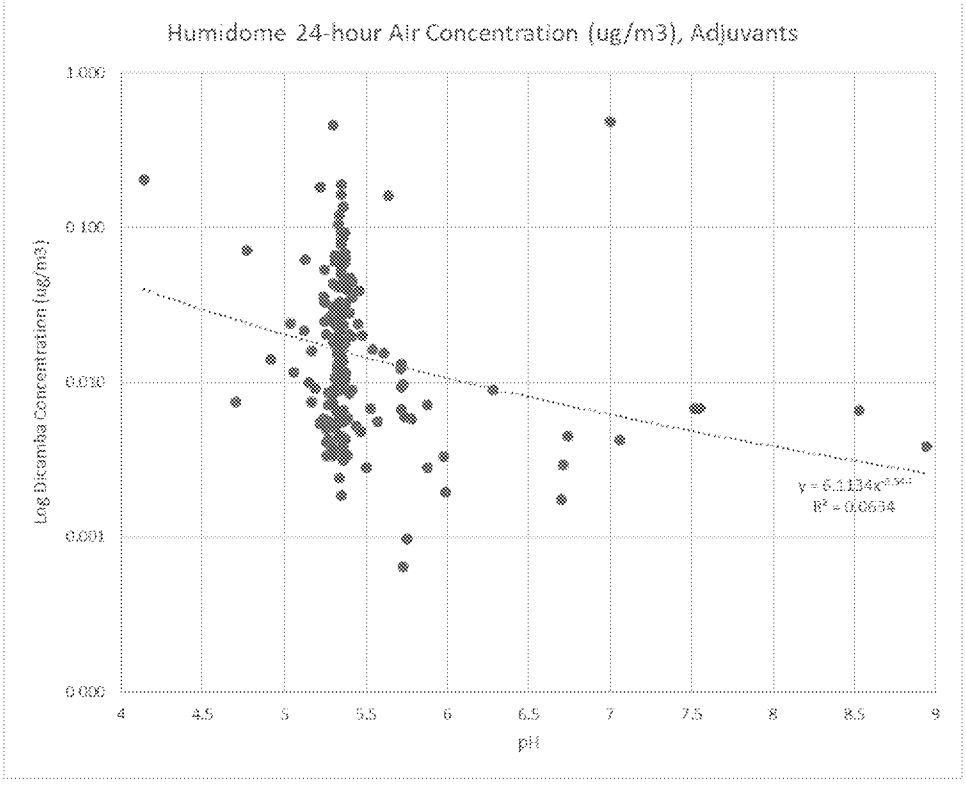


Figure 3. Relationship between pH and 24-hour dicamba air concentrations, fungicides.

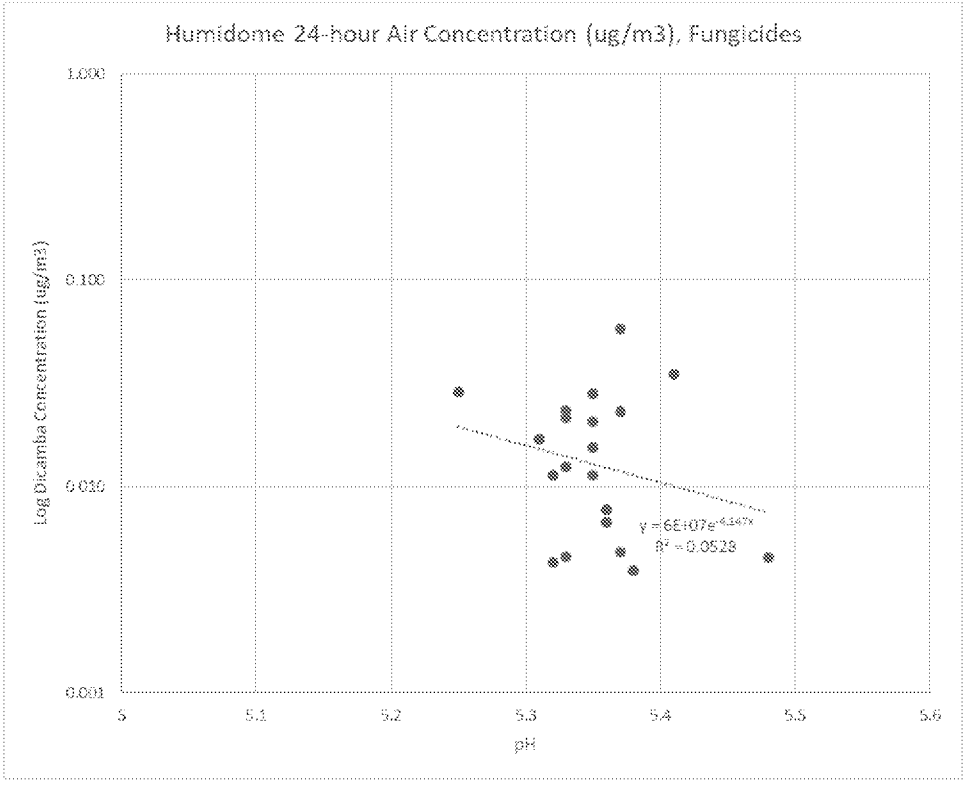


Figure 4. Relationship between pH and 24-hour dicamba air concentrations, herbicides.

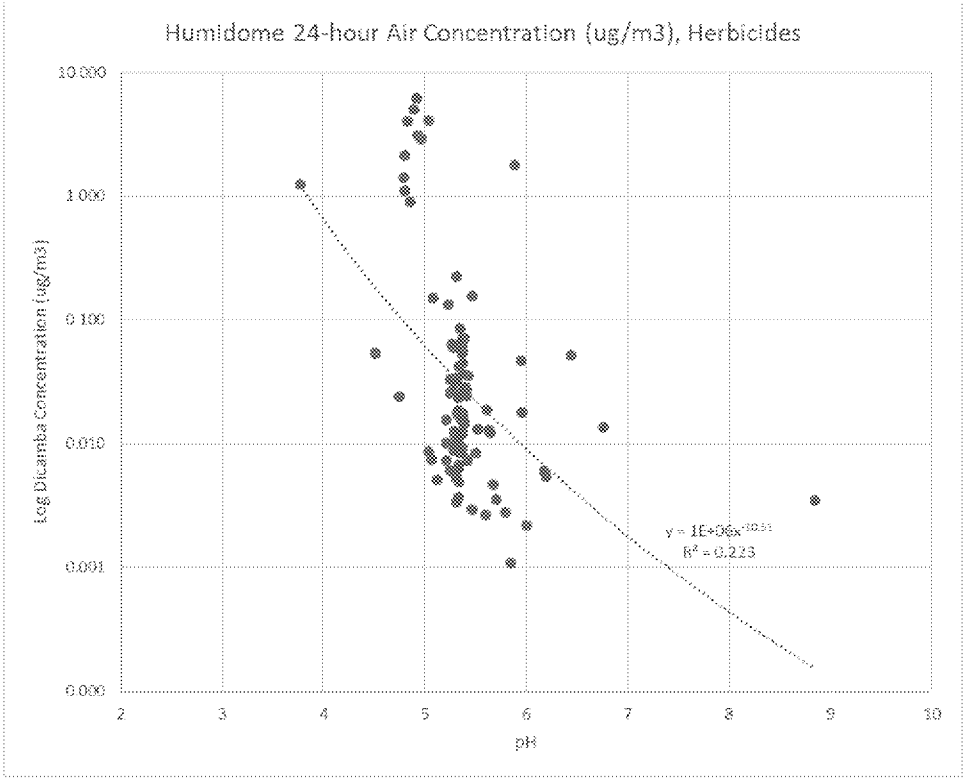


Figure 5. Relationship between pH and 24-hour dicamba air concentrations, insecticides.

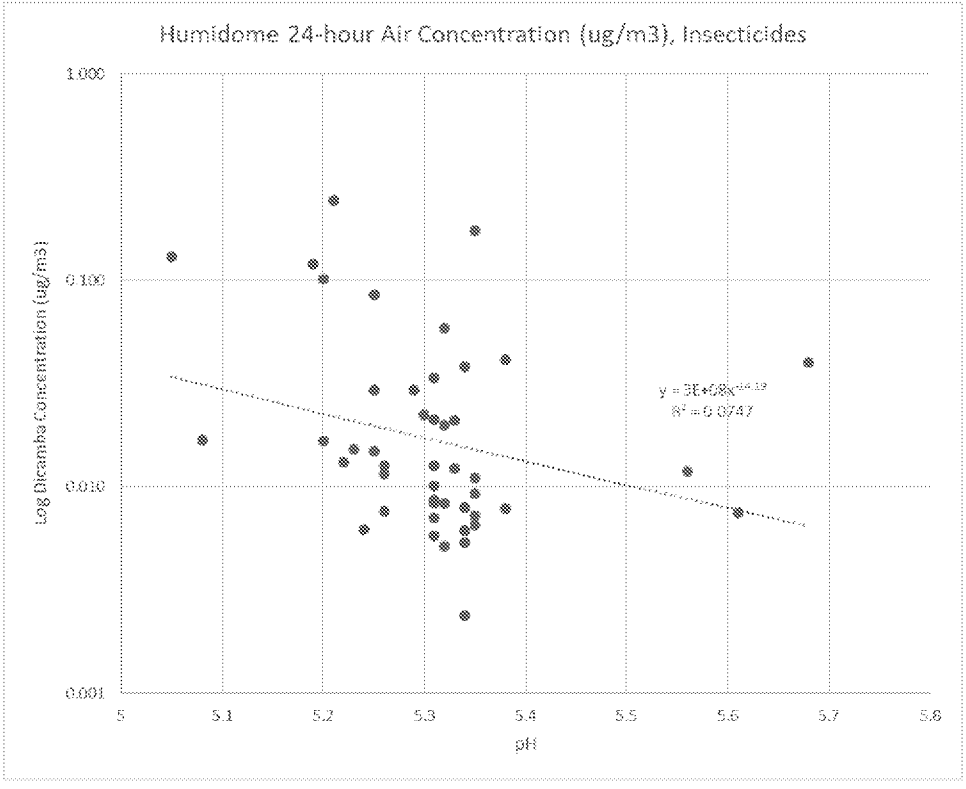


Figure 6. Relationship between pH and 24-hour dicamba air concentrations, nutritionals.

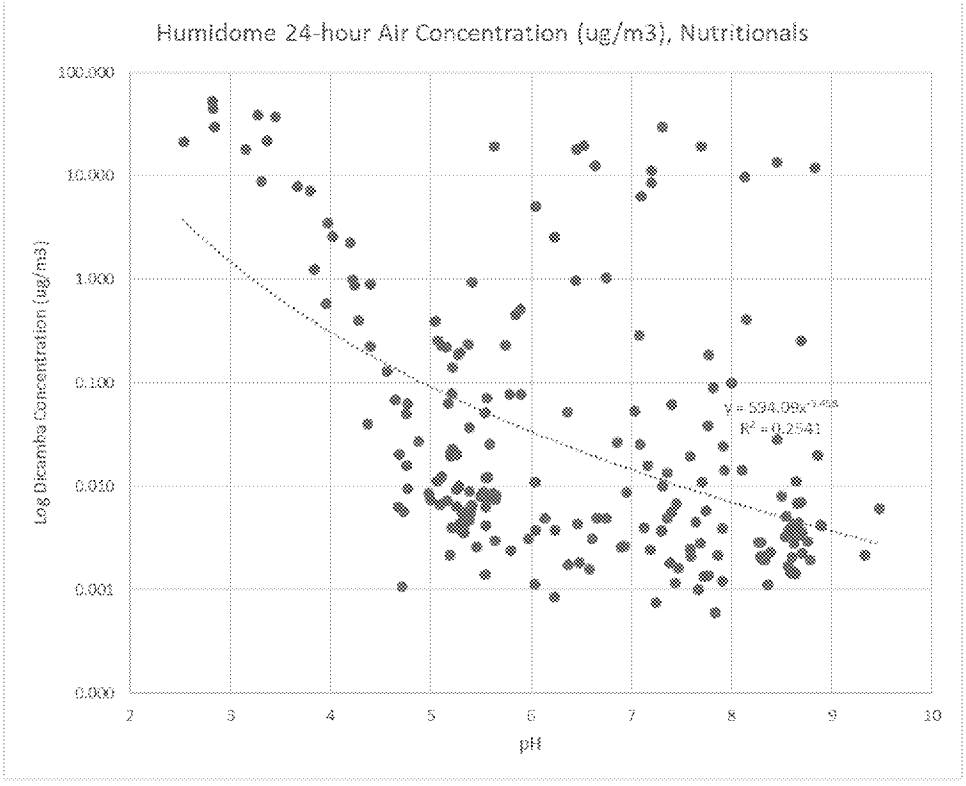


Figure 7. Relationship between pH and 24-hour dicamba air concentrations, other.

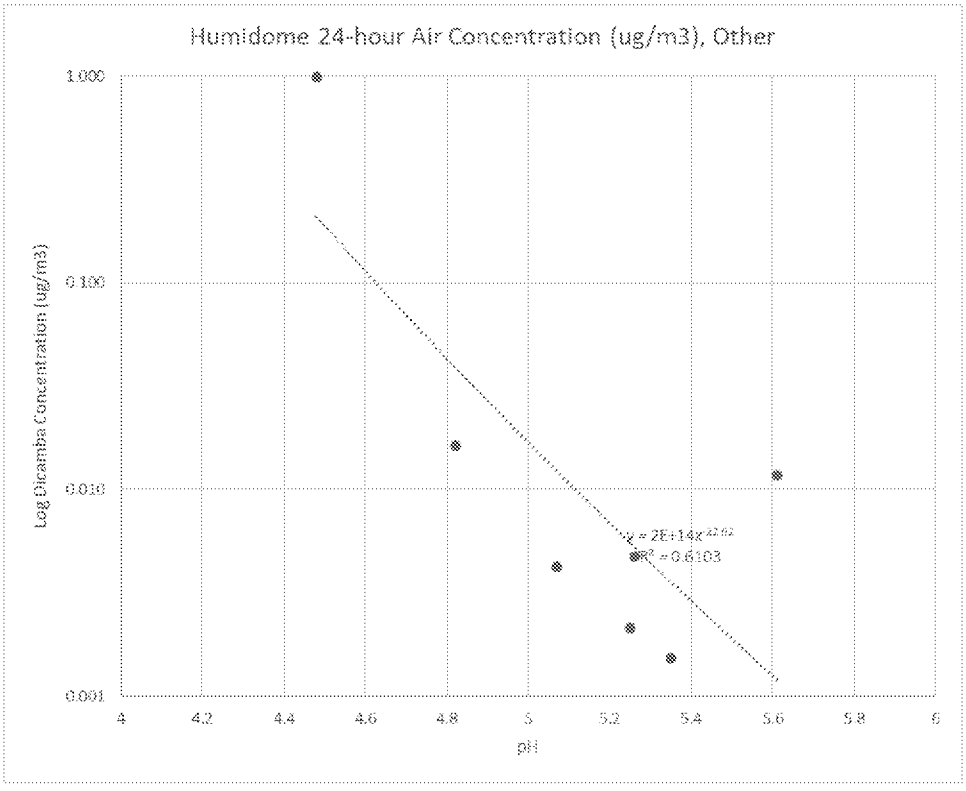
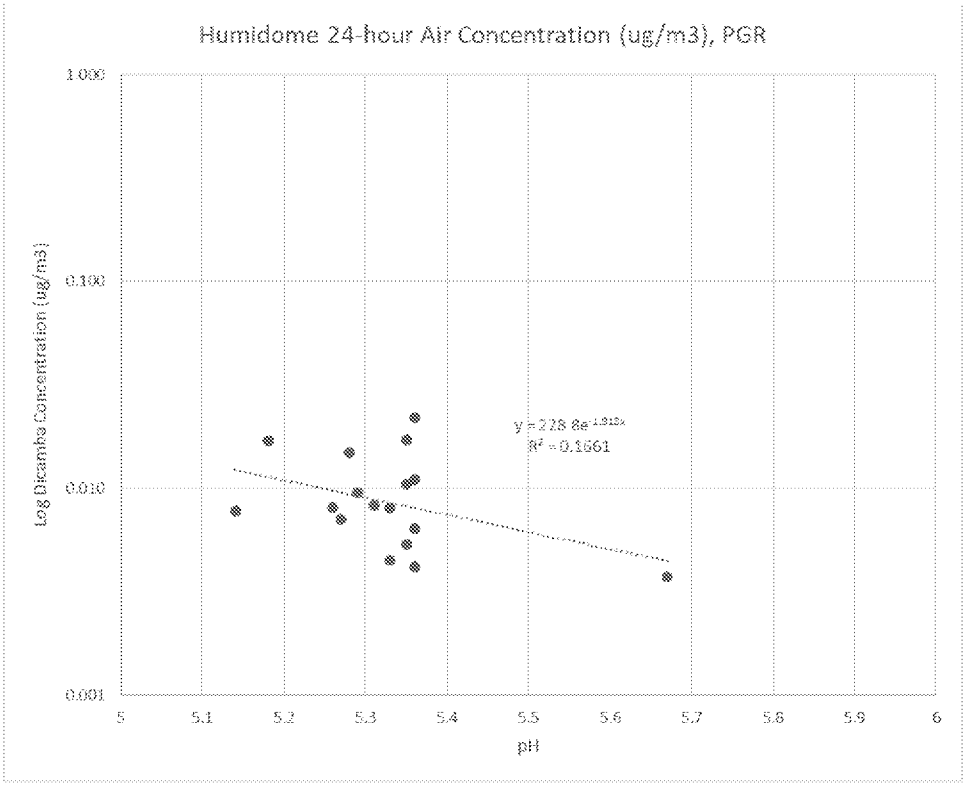


Figure 8. Relationship between pH and 24-hour dicamba air concentrations, PGR.



III. Study Deficiencies and Reviewer's Comments

1. The study report was the summary presentation of a large database of humidome test results compiled by Monsanto using XtendiMax™ with VaporGrip™ to compare air concentrations of dicamba after 24 hours with the pH of the tank mix. Only the tank mix pH and 24-hr air concentrations of dicamba were reported for each unique tank mix. No experimental details regarding the soil, humidomes, environmental conditions (temperature and humidity), replicate number, and analytical methods were reported. It is assumed that the experimental details were the same as those reported in Gavlick, et al, 2016.

2. The compositions of the test substances were not reported. Tank mix partners are reported in the supporting spreadsheet.

3. The test soil was not characterized. ASTM protocol STP1587, used in the conduct of this study, requires that "In order to minimize variability due to the soil composition, a one to one mixture of US10 field soil and Redi-Earth was used. Although different soil types may impact volatility, using this standard soil mixture helped reduce the impact of this variable." Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not as absolute values.

4. No method validation data were reported for the method used to quantify dicamba in the PUF.

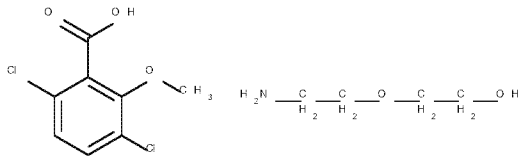
5. PUF samples were only collected at study termination (24 hours).

IV. References

1. U.S. Environmental Protection Agency. 2008. Fate, Transport and Transformation Test Guidelines, OCSPP 835.1410, Laboratory Volatility. Office of Chemical Safety and Pollution Prevention, Washington, DC. EPA 712-C-08-011.

2. Gavlick, W.K., Wright, D.R., MacInnes, A., Hemminghaus, J.W., Webb, J.K., Yermolenka, V.I., and Su, W. 2016. "A Method to Determine the Relative Volatility of Auxin Herbicide Formulations." Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587, G.R. Goss, Ed., ASTM International, West Conshohocken, PA, pp. 24-32. doi:10.1520/STP15842015000.

DER ATTACHMENT 1. Dicamba-diglycolamine and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT						
Dicamba-diglycolamine (Diglycolamine salt of dicamba)	**IUPAC:** 3,6-Dichloro-o-anisic acid-2-(2-aminoethoxy)ethanol **CAS:** 2-(2-Aminoethoxy)ethanol;3,6-dichloro-2-methoxy-benzoic acid **CAS No.:** 104040-79-1 **Formula:** $C_{12}H_{17}Cl_2NO_5$ **MW:** 326.17 g/mol **SMILES:** COc1c(Cl)ccc(Cl)c1C(=O)O.NCCOCCO		Non-guideline	51017511	NA	NA
MAJOR (>10%) TRANSFORMATION PRODUCTS						
No major transformation products were identified.						
MINOR (<10%) TRANSFORMATION PRODUCTS						
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

[A] AR means "applied radioactivity". MW means "molecular weight". NA means "not applicable".

Attachment 2: Statistics Spreadsheets and Graphs

128931_51017511_DE
R-Fate_NG_Humidome